PATENT SPECIFICATION 1,032,291

DRAWINGS ATTACHED.

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1,032,291

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Int. Cl.:— F 06 l.

COMPLETE SPECIFICATION.

Improvements in and relating to Refractory Sleeve Sheaths.

We, MORGANITE CRUCIBLE LIMITED of Norton Works, Woodbury Lane, Norton, Worcester, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to refractory sleeve sheaths, particularly for the metal rods of stoppers for the nozzles of ladles used for delivering molten metal, especially steel, into moulds. The invention is however applicable also to refractory sleeve sheaths for protecting other rods against the effect of molten metal or other intensely hot material.

The invention will be described as applied to a sheath for the stopper rod of a steel ladle, such a stopper consisting of a refractory plug head carried by the lower end of a metal rod sheathed by refractory sleeves protecting the rod against molten metal through which the rod extends downwardly in a steel ladle for the plug head of the stopper to obturate an outlet nozzle in the bottom of the ladle.

Stopper-rod sleeves are usually made of a fireclay material and these are generally satisfactory except in contact with some steels or slags which are particularly corrosive or when immersed in molten metal for long periods.

For the more severe requirements, of resisting corrosion and long immersion, sleeves of clay-graphite refractory material are more satisfactory, being stronger, more robust and having a longer life than fireclay sleeves. Such clay-graphite sleeves may be used throughout the length of a stopper rod or only at parts thereof particularly liable to corrosion or thermal shock, such as in the region of the slag in a steel ladle, fireclay sleeves being used for the remainder of the rod.

The thermal conductivity of clay-graphite material is considerably higher than that of fireclay and consequently the transmission of heat through a clay-graphite sleeve can result in over-heating and possibly softening of the sheathed stopper rod.

Also, at the joints between opposed ends of adjacent sleeves there may be a relatively high transmission of heat to the metal rod even though the joints are cemented and may be of spigot and socket form.

According to the invention, a thermal insulating sleeve sheath of refractory material, for a metal rod of given maximum diameter, has a bore of which at least the major part of the length thereof is of substantially greater diameter than said maximum rod diameter and inward projections are provided in the bore to present only a small total area for contact with a sheathed rod and thus form spacers preserving a clearance between a sheathed rod and the major part of the bore surface.

Such a sheath, with spacing projections in its bore, consequently has only relatively small thermal conducting contact with the rod and, according to the radial depth of the projections, insulating space is provided around the rod in the bore of the sheath. Such insulating space may be an air space but could be filled with an insulating material such as clean sand, fired refractory particles (known as " grog "), exfoliated vermiculite or magnesia.

In one construction in accordance with the invention, the bore of the sheath, or of a sleeve component of a sheath, is longitudinally ribbed so that the crests of the ribs

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provide only relatively small contact areas for the rod and the flutes, i.e. the spaces between the ribs, provide insulating spaces.

According to another construction of the invention, in a sheath composed of sleeves of refractory material assembled end-to-end on a metal rod, the opposed ends of adjacent sleeves are shaped to define conjointly a circumferential recess in the bore of the sheath and in such recess there is provided a ring of refractory material forming a bush at the joint.

Each bush ring may itself provide an inward projection in the bore of the sheath and thus form a spacer preventing contact between the rod and the major part of the bore surface. The bores of the sleeves may also have ribs or other projections or may be smooth and of relatively large diameter, the bush rings then serving instead of ribs or other projections in the sleeve bores.

Alternatively, the inner diameter of the bush rings, when used with sleeves having bore ribs or other projections, may be large enough to provide a clearance around the metal rod.

In any case, the bush rings mask the joints between opposed sleeve ends so as to reduce transmission of heat to the metal rod at such joints.

The present invention is illustrated, by way of example, on the drawing accompanying the Provisional Specification of Application No. 380/63 (Serial No. 1,032,291) in which:—

Fig. 1 is an end elevation of a sheath sleeve.

Figs. 2 and 3 are fragmentary end elevations of sleeves showing alternative rib shapes,

and on the drawings accompanying the Provisional Specification of Application No. 12609/63 (Serial No. 1,032,291), in which:—

Fig. 4 is an interrupted axial section of part of a sheathed metal rod,

Fig. 5 is an end view of a bush ring such as is shown in Fig. 4,

Fig. 6 is a view, similar to Fig. 4, showing an alternative sheath construction,

Fig. 7 is an end view of a sleeve such as is shown in Fig. 6 and

Fig. 8 is an end view of a bush ring such as is shown in Fig. 6.

As shown by Figs. 1, 2 and 3, a refractory sleeve 1 has its bore formed with longitudinal ribs which may be of convexly arcuate cross-sectional shape, for instance the circular segmental ribs 2 in Fig. 1, angular cross-sectional shape, for instance the V-section ribs 3 in Fig. 2, or concavely arcuate cross-sectional shape, for instance the ribs 4 in Fig. 3.

Any of the ribs illustrated, or other longitudinal ribs, may conveniently be formed in extrusion of sleeves from refractory material in a plastic state before firing.

The outline of the periphery of a rod 5 through the respective sleeve is indicated in broken lines in Figs. 1, 2 and 3 and it can be seen that the area of contact of the rod and sleeve bore surfaces is small, with relatively large air spaces provided by the flutes between the ribs.

Instead of ribs, other projections could be provided, for example bosses or interrupted rings at intervals along the sleeve bore, but longitudinal ribs are preferred, being relatively easily formed.

The invention enables refractory material of relatively high thermal conductivity to be used for rod-sheathing sleeves, particularly for ladle stopper rods, a preferred material being clay-graphite of which a typical example is 30—50% clay, 20—35% refractory "grog" and 15—40% graphite.

Examples of other relatively high thermal conductivity refractory materials suitable for sleeves are silicon carbide, materials containing silicon carbide or carbon, chrome, magnesite and chrome/magnesite.

In the construction shown by Figs. 4 and 5, the metal rod 10 has a sheath made up by one or more relatively closely fitting sleeves 11, made of a low thermal conductivity material such as fireclay, covering a part of the rod for which such sleeves give adequate protection, and two or more relatively large-bore sleeves 12 of a material, such as clay-graphite, giving greater protection to the rod but having a relatively high thermal conductivity.

The opposed ends of the sleeves 12 are rebated at 13 on their inner peripheries so as to define a circumferential recess for a bush ring 14 which is also made of clay-graphite, or equivalent material, and has ribs 15 (Fig. 5) in its bore so as to reduce its contact with the rod 10. As can be seen from Fig. 4, the brush ring 14 forms a spacer for the sleeves 12, which could however also be internally ribbed, and masks the joint between the sleeves 12 so that there is not a direct path for transmission of heat through the joint.

As is usual, the sleeve joints are cemented as indicated at 16.

In the construction shown by Figs. 6 to 8, clay-graphite or like material sleeves 17 have bore ribs 18 and rebates 19 forming, at the joint between opposed ends of adjacent sleeves 17, a recess for a bush ring 20 which has a relatively large inner diameter and serves only to mask the joint between the sleeves 17 without itself making contact with the rod 10.

WHAT WE CLAIM IS:—

1. A thermal insulating sleeve sheath of refractory material, for a metal rod of a given maximum diameter, the sheath having

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a bore of which at least the major part of the length thereof is of substantially greater diameter than said maximum rod diameter and inward projections are provided in the bore to present only a relatively small total area for contact with a sheathed rod and thus form spacers preserving a clearance between a sheathed rod and the major part of the bore surface.

2. A sleeve sheath according to claim 1, in which the bore of the sheath, or of a sleeve component of the sheath, is longitudinally ribbed so that the crests of the ribs provide only relatively small contact areas for the rod and the flutes provide insulating spaces.

3. A sleeve sheath according to claim 1 and composed of sleeves of refractory material assembled end to end on a metal rod, in which the opposed ends of adjacent sleeves are shaped to define conjointly a circumferential recess in the bore of the sheath and in such recess there is provided a ring of refractory material forming a bush at the joint.

4. A sleeve sheath according to claim 3, in which each bush ring provides an inward projection in the bore of the sheath and thus forms a spacer preventing contact between the rod and the major part of the bore surface.

5. A sleeve sheath according to claim 3, in which the sleeves have inward projections forming spacers and the bush rings have an inner diameter large enough to provide a clearance around the metal rod.

6. A thermal insulating sleeve sheath substantially as described with reference to any of Figs. 1, 2 and 3 of the drawing accompanying the Provisional Specification of Application No. 380/63 (Serial No. 1,032,291).

7. A thermal insulating sleeve sheath substantially as described with reference to Figs. 4 and 5 of the drawings accompanying the Provisional Specification of Application No. 12609/63 (Serial No. 1,032,291).

8. A thermal insulating sleeve sheath substantially as described with reference to Figs. 6, 7 and 8 of the dawings accompanying the Provisional Specification of Application No. 12609/63 (Serial No. 1,032,291).

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1032291 PROVISIONAL SPECIFICATION No. 38063
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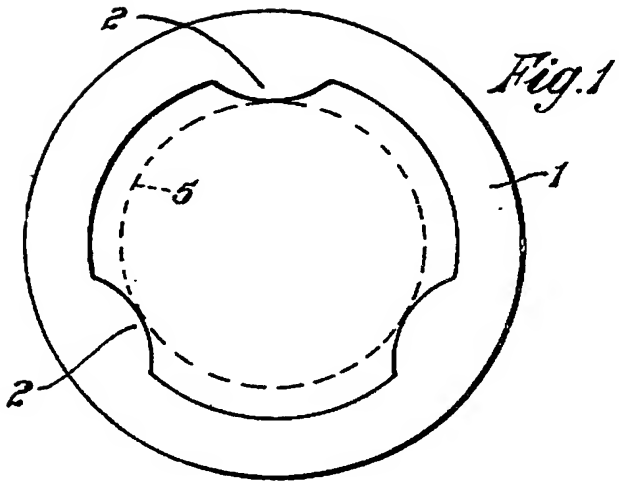

Fig.1

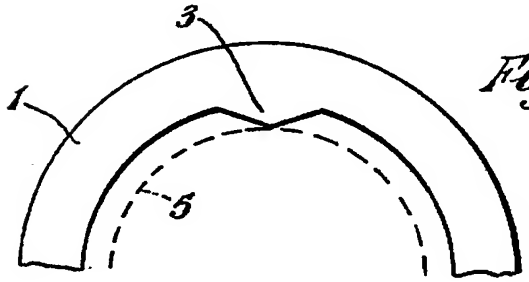

Fig.2

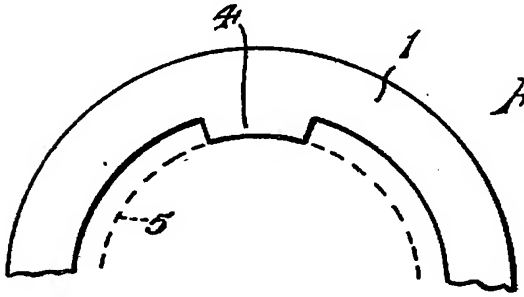

Fig.3

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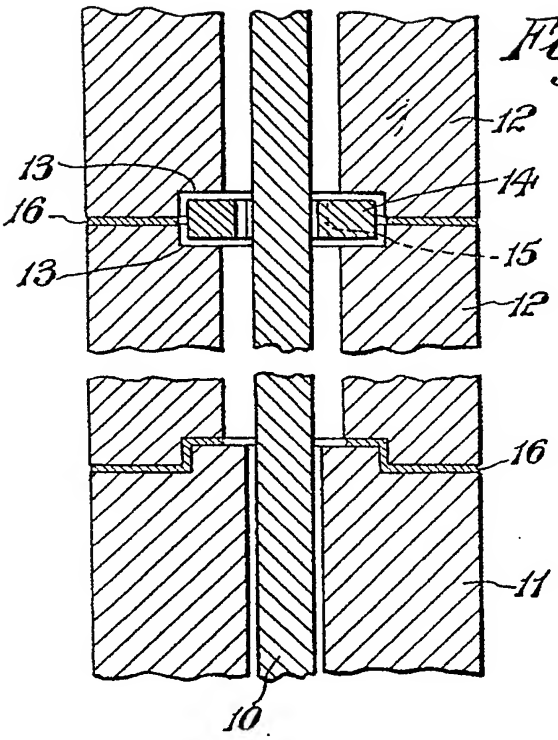

Fig. 4

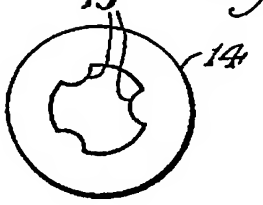

Fig. 5

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Sheets 1 & 2

7.4

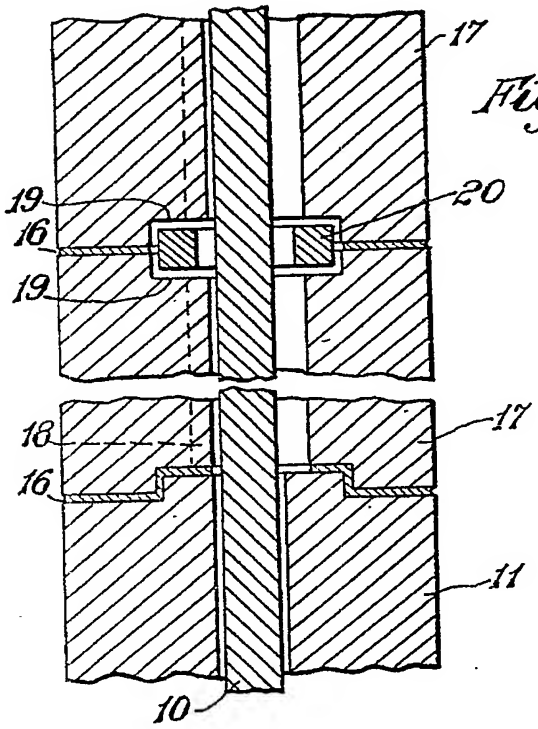


Fig. 6

Fig. 7

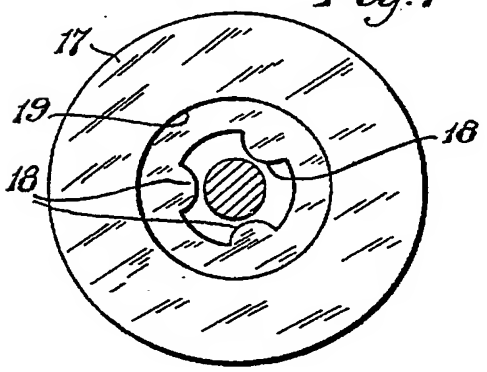
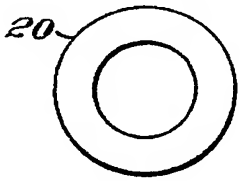


Fig. 8



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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

Fig.4

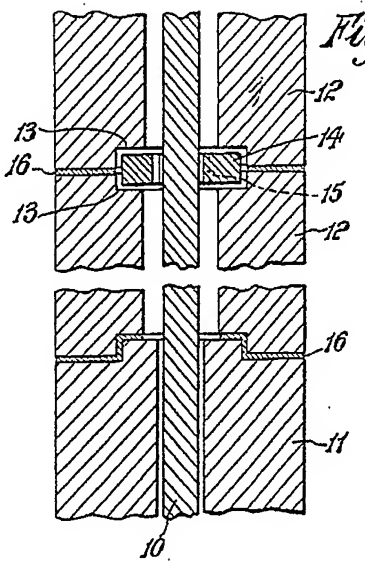

Fig.5

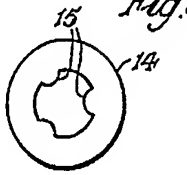

Fig.6

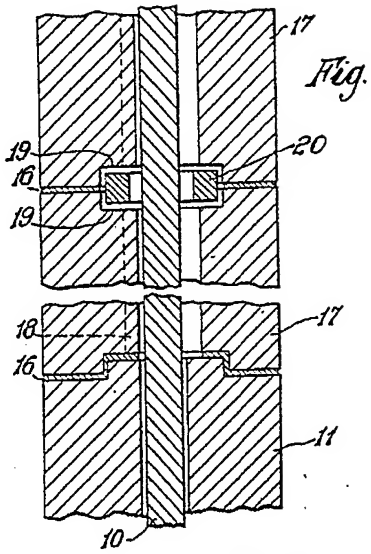

Fig.7

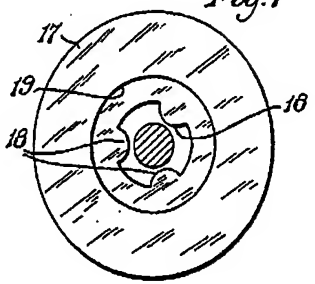

Fig.8